Attorney Docket No.: 114183-7
Ref. No.: P98-0040US2
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Daniel J. Woodruff et al.

Application No.: 10/084,962 Confirmation No.: 2206

Filed: February 27, 2002 Art Unit: 1742

For: ELECTROPLATING APPARATUS WITH SEGMENTED ELECTRODE ARRAY Examiner: Lois L. Zheng

DECLARATION OF DANIEL J. WOODRUFF AND KYLE M. HANSON UNDER 37 C.F.R. § 1.131

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

We, Daniel J. Woodruff and Kyle M. Hanson, hereby declare and say that:

1. We are employed by the assignee of the above-identified application, Semitool, Inc. ("Semitool") and have been named as joint inventors of the subject matter described and claimed in U.S. Patent Application No. 10/084,962, filed February 27, 2002, which is a continuation of U.S. Patent Application No. 09/113,418, filed July 10, 1998, and now U.S. Patent No. 6,497,801. This declaration is submitted to show conception and actual reduction to practice of the claimed invention in this country prior to February 12, 1998, and thus before the earliest filing date to which U.S. Patent No. 6,391,166 B1 claims priority.

2. Prior to February 12, 1998, we conceived and reduced to practice the invention presented in the claims of the above-captioned patent application. Our conception and actual reduction to practice of the claimed invention are each corroborated by (a) Semitool Invention Disclosure – 0006 for the concentric electrode array reactor (Exhibit A), (b) Semitool Fabrication Drawings for the concentric electrode array (Exhibit B), (c) Semitool Invention Disclosure – 0005 for the concentric electrode array reactor (Exhibit C), (d) Semitool Work Requests for building the components of the concentric electrode array (Exhibit D); and (e) Semitool Reactor Drawings for a preexisting reactor developed by Semitool (Exhibit E).

3. We prepared and signed Semitool Invention Disclosure – 0006 well before February 12, 1998, and this document was also witnessed and understood by two colleagues at Semitool before February 12, 1998. Semitool Invention Disclosure – 0006 lists dates of conception and written description before February 12, 1998.

4. The Semitool Fabrication Drawings include Semitool Drawing Nos. ATG0233-ATG0238, which were also prepared before February 12, 1998. Semitool Drawing No. ATG0233, more specifically, includes isometric, cross-sectional and exploded views that correspond to Figures 2-5 of the present application.

5. We also prepared and signed Semitool Invention Disclosure – 0005 before February 12, 1998, and this document was also witnessed by colleagues at Semitool before February 12, 1998. Semitool Invention Disclosure – 0005 lists the dates of conception and written description before February 12, 1998.

6. As shown in Semitool Invention Disclosure – 0006, the Semitool Fabrication Drawings, and Semitool Invention Disclosure – 0005, we conceived of a system for electroplating a layer of material on a semiconductor wafer. In one embodiment, such as set forth in claim 17, the system includes an electrochemical cell comprising a primary anode, a cathode contact, and a chamber in which the primary anode and the cathode are

disposed (Exhibit A, p. 1). We further conceived of one secondary anode for providing a variable current to the semiconductor wafer (Exhibits A-C), and using an electrolytic solution disposed within the electrochemical cell (Exhibit A, p. 1). We also conceived of applying different anode potentials to individual electrodes (Exhibit A, p. 2), and independently controlling the electrical potential to each anode to dynamically modify the anode configuration (Exhibit C, p. 1). We accordingly conceived of a power source capable of providing varying levels of voltage to a primary anode and a secondary anode.

7. We conceived of still further aspects of systems for electroplating a layer of material on a semiconductor wafer. For example, we conceived that the anodes can have a ring-shape (Exhibits A-C), the secondary anode can include a first secondary anode and a second secondary anode (Exhibits A-C), and/or the secondary anodes can comprise first and second concentric rings (Exhibits A and B). We further conceived that the wafer can act as a cathode to receive an electroplating film (Exhibit A, p. 1). We also conceived that a variable current or a variable voltage can be applied to the anodes (Exhibits A and C).

8. We also conceived of an anode system for performing an electroplating operation. In one embodiment, such as set forth in claim 32, such an anode system includes a plurality of anodes for performing an electroplating operation on a part (Exhibits A-C). We further conceived that the anodes are insulatively coupled together on a dielectric mount (Exhibit B, Semitool Drawing Nos. ATG0233 and ATG0234), and operating the anodes to provide a variable current to the plurality of anodes by varying the voltage levels (Exhibit C). We further conceived of a plurality of leads respectively coupled to the anodes such that the leads have the capability of providing independent electrical currents from a power source to respective anodes. More specifically, the anode mount illustrated in Semitool Drawing Nos. ATG0233 and ATG0234 (Exhibit B) include mounting holes through which individual leads can independently provide electrical currents to individual anodes.

9. After conceiving this invention, we reduced the invention to practice by constructing a prototype of the concentric electrode array according to Semitool Drawing Nos. ATG0233 to ATG0238 (Exhibit B) prior to February 12, 1998. More specifically, Semitool Work Requests 00474-00478 (Exhibit C) were submitted to Semitool's shop for fabricating the individual components shown in Semitool Drawing Nos. ATG0234 to ATG0238 well before February 12, 1998. Additionally, we indicated that the date needed for receiving the components of the concentric electrode array from the shop was also well before February 12, 1998. We proceeded to assemble the components illustrated in Semitool Drawing Nos. ATG0234 to ATG0238 and the concentric electrode assembly shown in Semitool Drawing No. ATG0233 was fabricated and assembled well before February 12, 1998.

10. Semitool had also created reactor vessels before February 12, 1998. For example, sheets 1-3 of Semitool Drawing Nos. 100T0041 (Exhibit E) were created well before February 12, 1998. No inventive effort was required to assemble the concentric electrode assembly shown in Semitool Drawing No. ATG0233 (Exhibit B) with the vessel illustrated in Semitool Drawing No. 100T0041 (Exhibit E) as shown in Semitool Invention Disclosure – 0006 (Exhibit A, p. 1).

11. We previously submitted a declaration under 37 C.F.R. § 1.131 that demonstrated we further conceived and reduced to practice the subject matter of the claims in this application before April 21, 1998, which is the earliest filing date claimed by U.S. Patent No. 6,261,433 issued to Landau (Exhibit F). As stated in our previous declaration under 37 C.F.R. § 1.131 directed to U.S. Patent No. 6,261,433, the electrode array was built, installed in a plating reactor as described in the present application, and successfully tested before April 21, 1998.

12. The dates contained on each of the Exhibits have been removed, but all of the dates in Exhibits A-E are before February 12, 1998, and thus corroborate the

conception and actual reduction to practice of the subject matter disclosed and claimed in the present application.

13. We further declare that all statements herein made of our own knowledge are true, and that all statements made on information or belief are believed to be true; and further, that the statements are made with the knowledge that the making of willful or false statements or the like is punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and may jeopardize the validity of any patent issuing from this patent application.

Dated this 12TH day of JANUARY, 2006.

Kyle M. Hanson

Daniel J. Woodruff

EXHIBIT A

INVENTION DISCLOSURE

SEMITOOL, INC. D. 0006

Note:
1. Use Ink or Type Only
2. Do not erase errors. Line through any errors, initial and date.
3. Describe invention with drawings, sketches, etc. and a written explanation. Drawings may be below or attached. If attached, the inventor(s) and witnesses must sign and date each sheet.
4. Describe the advantages of this invention compared to the current approach, if any.
5. Inventor(s) and two (2) witnesses must sign and date each sheet.
6. Send original signed documents to the Intellectual Property Department. Retain a personal copy.

Inventor(s) Name and Social Security Number

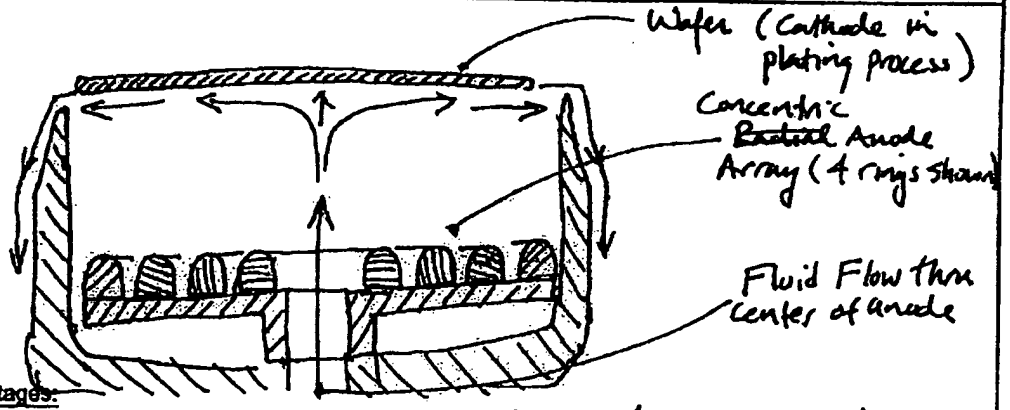
Daniel J. Woodruff
Kyle M. Hanson

Title of Invention: TOOL: Plating

Concentric Anode Array with Centered Fluid Flow

Invention:

Sketch



Explanation and Advantages:

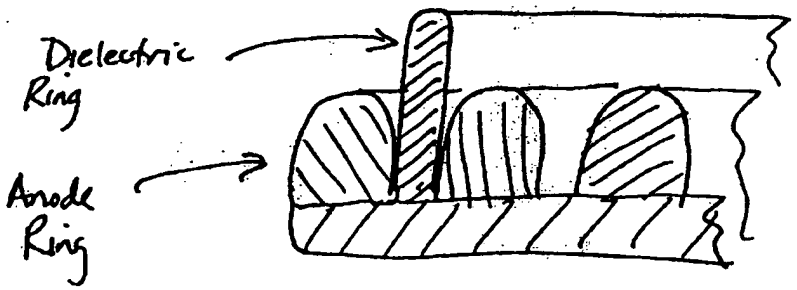
Plating fluid is pumped through the center of the anode array and impinges on the wafer surface. The plating rate on the wafer surface will vary radially ~~across the~~ due to the effect of the impinging fluid on the hydrodynamic boundary layer. This radial effect can be compensated for ~~in the~~ by operating the anode rings at different electrical potentials.

(continued on attached sheet)

Signature(s) of Inventor(s):	Date:	Date of Conception:	Date of First Sketch/Drawing:
Witnessed and Understood By:	**Date:**	**Date of Written Description:**	**Working Model Prepared?**
			Yes/No Date:

Explanation and Advantages (Cont.)

In addition to affecting plating uniformity by using different anode potentials it would also be possible to affect uniformity with dielectric (insulating) material placed between the anode ring (see sketch



The geometry of the dielectric material could be modified to provide the desired effect on plating. Tall geometries would tend to limit interaction of adjacent anodes (and perhaps collimate current flow to the wafer) while shorter or perforated geometries would tend to increase anode interaction. Similar effects may also be possible by positioning the anode rings at varying distances from the wafer surface.

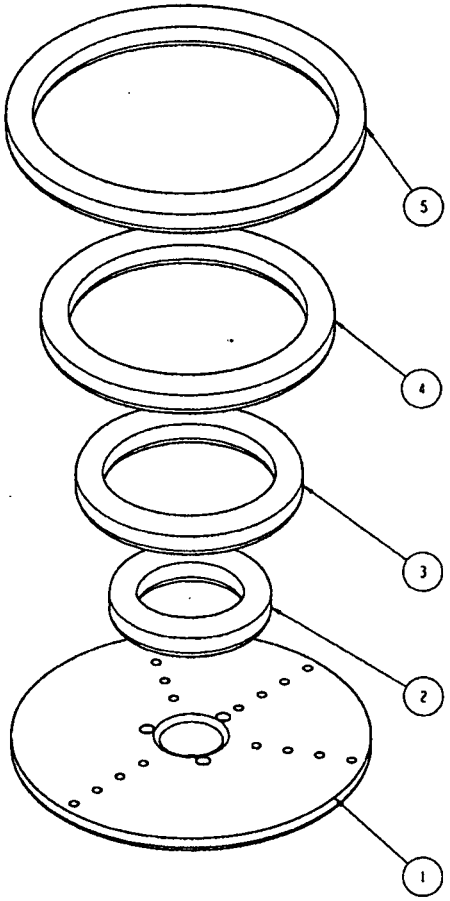
The advantages to this design are:

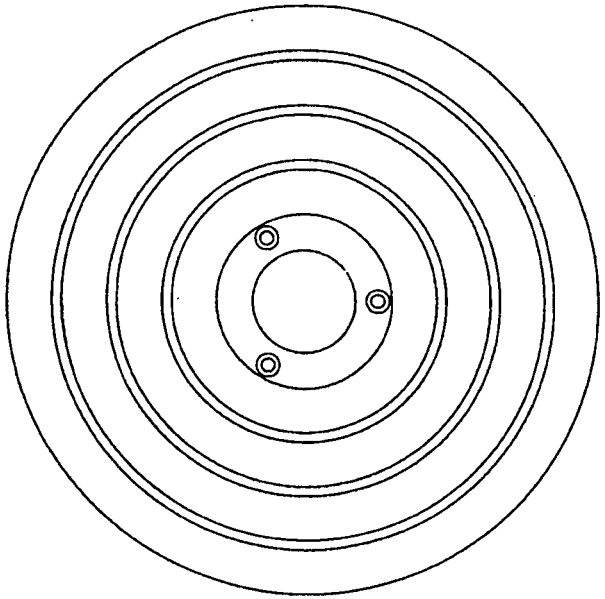
1) No diffuser is required between the anode and wafer. Fluid flow rate and current distribution can be controlled independent of one another in the proposed design but can't in the existing system which uses a diffuser constructed of dielectric material. Having these variable independently controllable makes it easier to optimize the plating process.
2) Air bubbles introduced into the plating chamber by the incoming fluid flow are simply flushed passed the wafer surface and won't interfere with the plating process. With the existing system utilizing a diffuser these bubbles can attach to the diffuser surface and adversely impact diffuser performance
3) Fluid flow through the center of the anode ensures the wafer surface will be wetted from the center out. This will prevent air being trapped at the center of the wafer when it first contacts the fluid surface

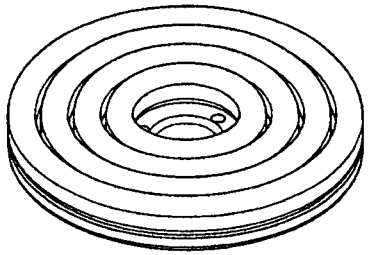
Daniel J. Woodruff

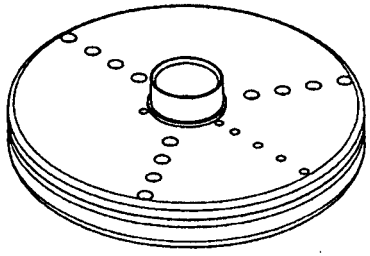
EXHIBIT B

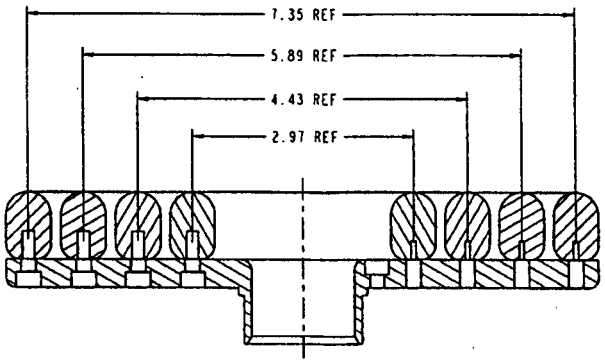
REV	INIT	DESCRIPTION	EXPOSITION	DATE	APPVD











FIND No.	QTY	PART NUMBER	DESCRIPTION
1	1	ATG0234	MOUNT, ANODE, RADIAL ARRAY
2	1	ATG0235	ANODE, RING, 2.97 DIA.
3	1	ATG0236	ANODE, RING, 4.43 DIA.
4	1	ATG0237	ANODE, RING, 5.89 DIA.
5	1	ATG0238	ANODE, RING, 7.35 DIA.

MATERIAL	-
FINISH	-
NEXT HIGHER ASSY	ATG0233

TOLERANCES UNLESS NOTED
.XX ± 0.010
.XXX ± 0.010
ANGULARITY ± 0.5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

SEMITOOL™ KALISPELL, MT

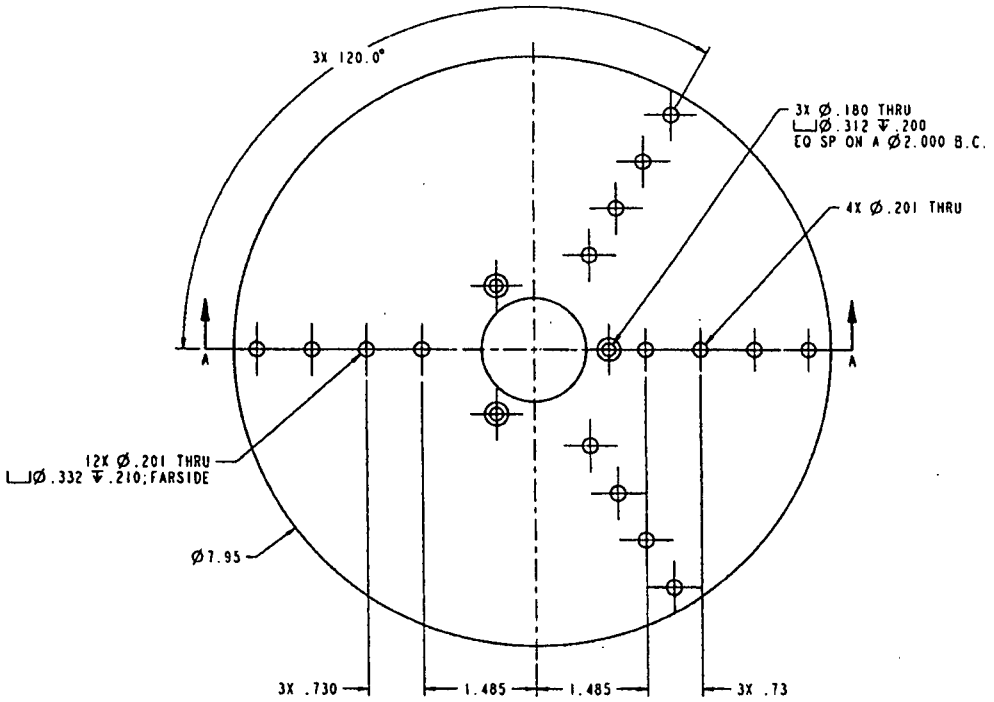
ANODE ASSEMBLY, VARIABLE ARRAY

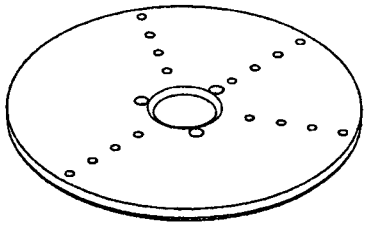
			JJE	
			DJW	
DASH NO(S)	WHERE USED	DRAW	CHK'D	

SIZE 8 | DWG NO ATG0233 | REV -

SCALE 0.375 | SHEET 1 of 1

SEMITOOL PROPRIETARY





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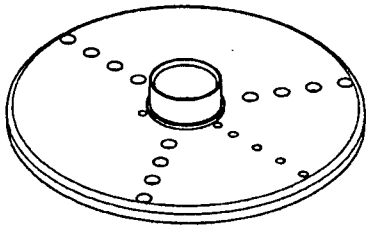

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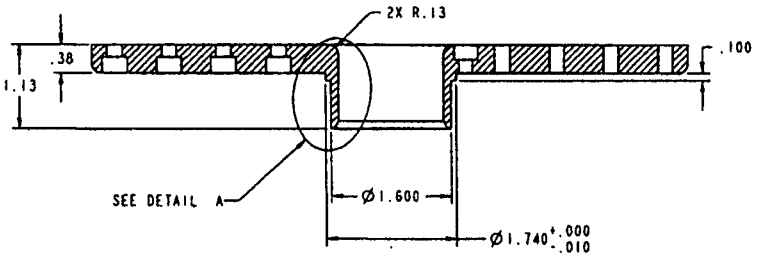
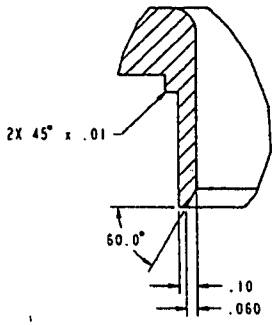


SECTION A-A



DETAIL A
SCALE 1.500

REVISIONS

REV	SHT	DESCRIPTION	DISPOSITION	DATE	APPVD

MATERIAL	XPP, SHEET 1 1/8"
FINISH	-
MODEL OR DRAWING	ATG0234

TOLERANCES UNLESS NOTED
.XX ± .020
.XXX ± .010
ANGULARITY ± .5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

SEMITOOL™ KALISPELL, MT

MOUNT, ANODE, VARIABLE ARRAY

DRAWN	JJE
CHECKED	DJW

SIZE	FSCM NO.	DWG NO.	REV
B		ATG0234	

SCALE 0.625 SHEET 1 of 1

DASH NO(S)	WHERE USED	QUAD	REVISION NOTE

REVISIONS					
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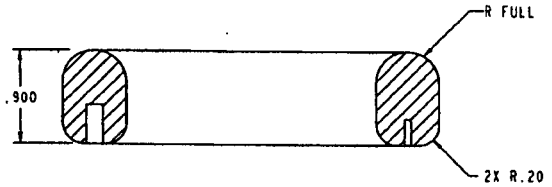
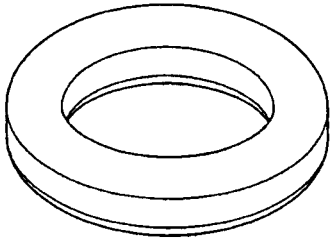


SECTION A-A



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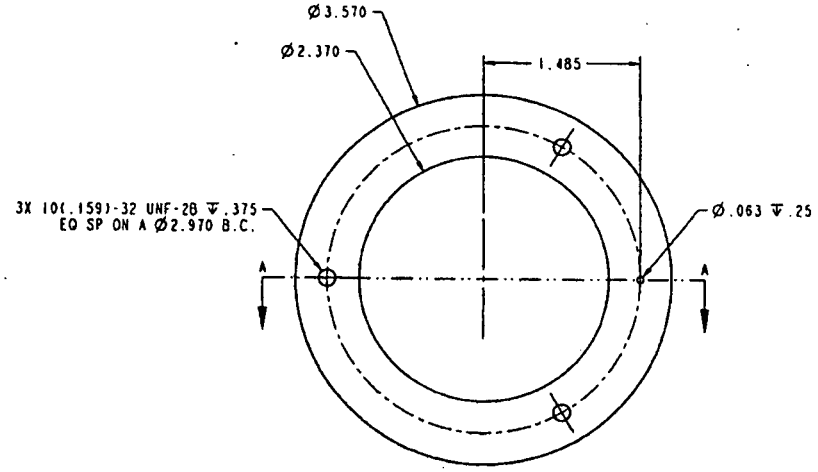

TOLERANCES UNLESS NOTED
.XX ± 0.020
.XXX ± 0.010
ANGULARITY - ±.5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES
UNLESS NOTED

			DRAWN	JJE	
			ENGINEER	DJW	
DASH NO(S)	WHERE USED	CLASS	CREATION DATE		

MATERIAL	COPPER 99.9%
FINISH	-
MODEL OR PART NO.	ATG0235

SEMITOOL™ KALISPELL, MT

ANODE, RING, 2.97 DIA.

-

-

SIZE	TYPE OR CL.	DWG. NO.	REV
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SCALE 0.875		SHEET 1 of 1	

REVISIONS					
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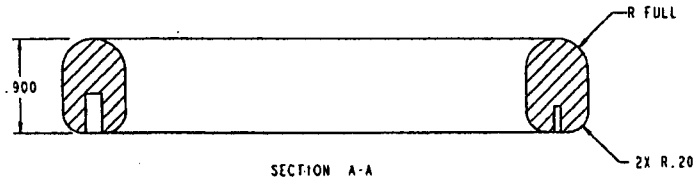
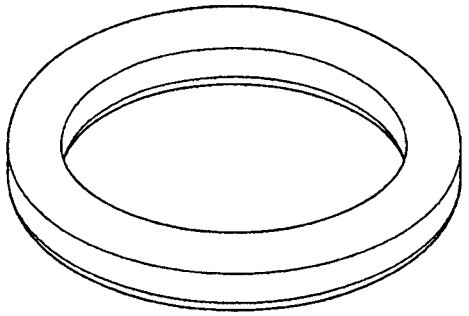


SECTION A-A



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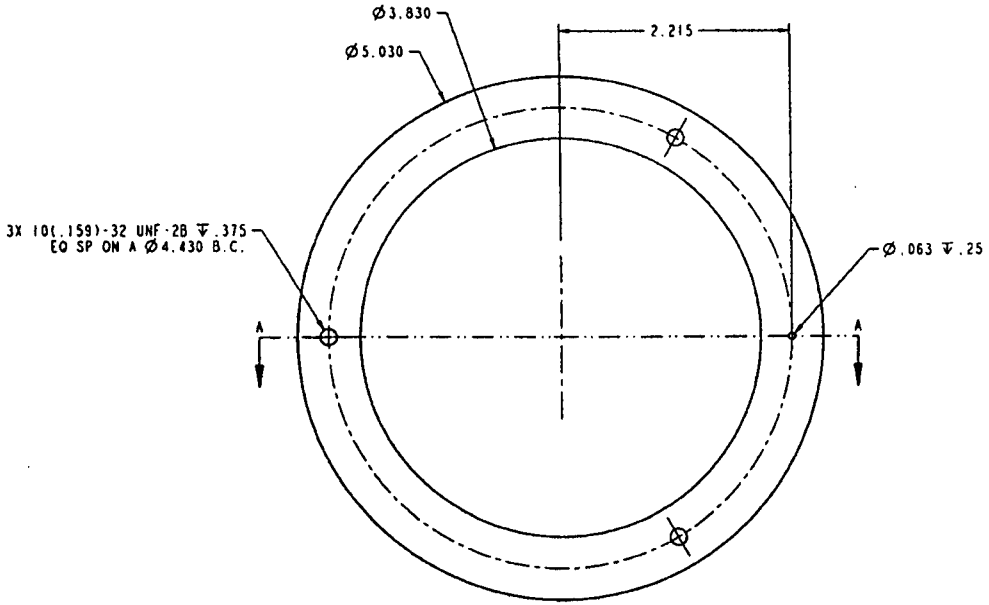

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FINISH	-
PART NO. OR IDENT	ATG0236

TOLERANCES UNLESS NOTED
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.XXX - ±.010
ANGULARITY - ±.5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES
UNLESS NOTED

SEMITOOL™ KALISPELL, MT

ANODE, RING, 4.43 DIA.

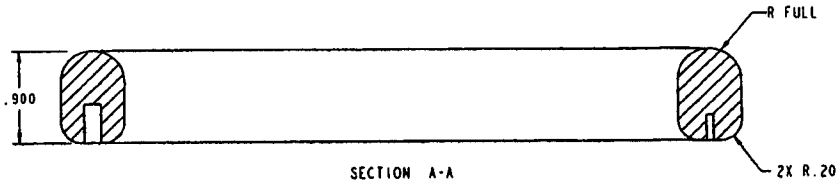
			DRN	JJE	
			CHKD	DJW	
BASH NO(S)	WHERE USED	QUAD			

SIZE B | DWG NO. ATG0236 | REV

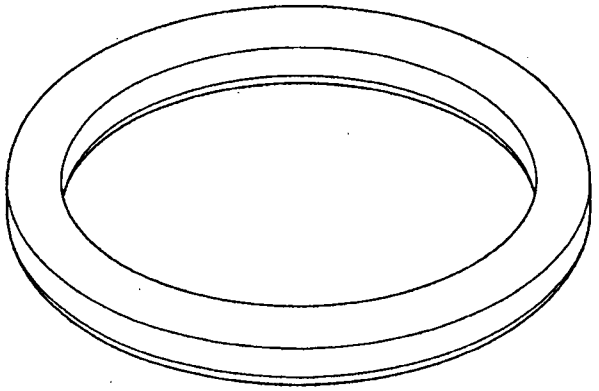
SCALE 0.875 | SHEET 1 of 1

SEMITOOL PROPRIETARY

REVISIONS					
REV	ENG	DESCRIPTION	DISPOSITION	DATE	APPVD



SECTION A-A



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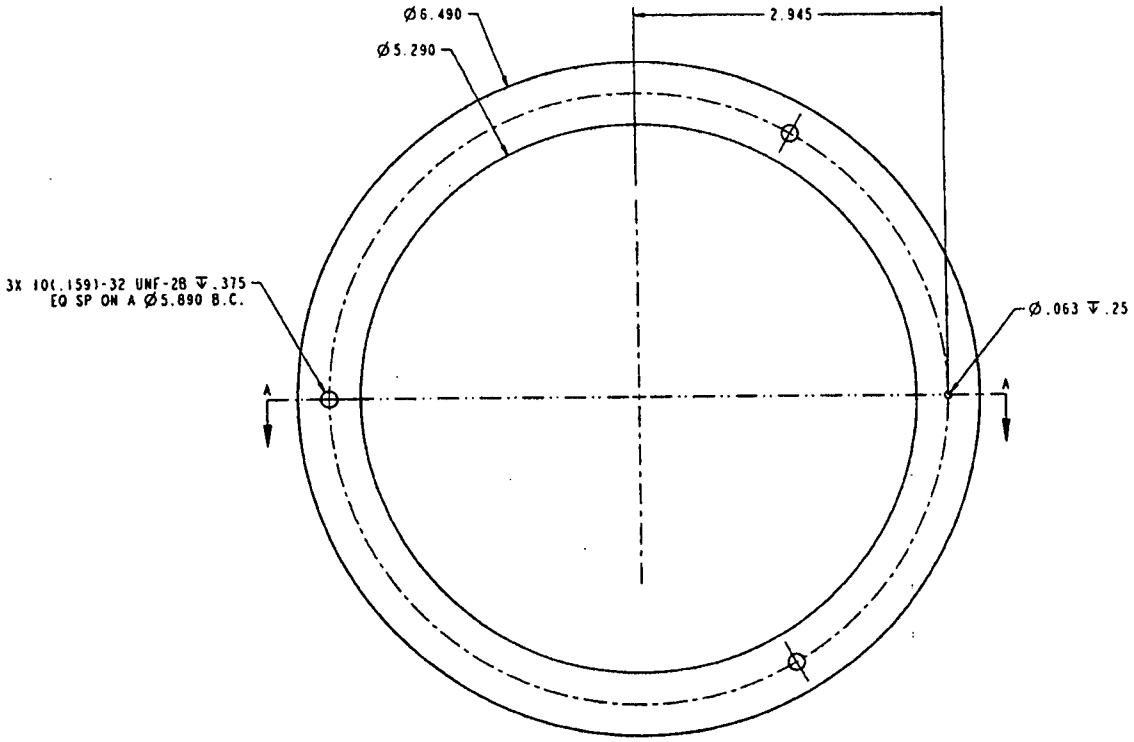


MATERIAL	COPPER 99.9%
FINISH	-
PART NO.	ATG0237

TOLERANCES UNLESS NOTED
.XX = ±.020
.XXX = ±.010
ANGULARITY = ±.5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

SEMITOOL™ KALISPELL, MT

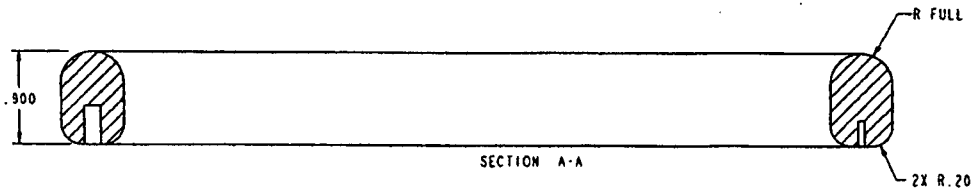
ANODE, RING, 5.89 DIA.

			DRAWN	JJE	
			ENGINEER	DJW	
DASH NO(S)	WHERE USED	QUAN	REVISION PER		

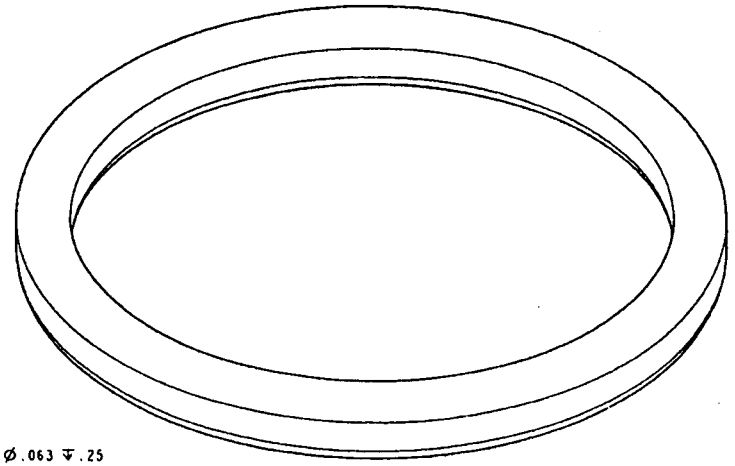
SIZE B | DWG NO. ATG0237 | REV

SCALE 0.875 | SHEET 1 of 1

REVISIONS					
REV	SHT	DESCRIPTION	DISPOSITION	DATE	APPVD



SECTION A-A



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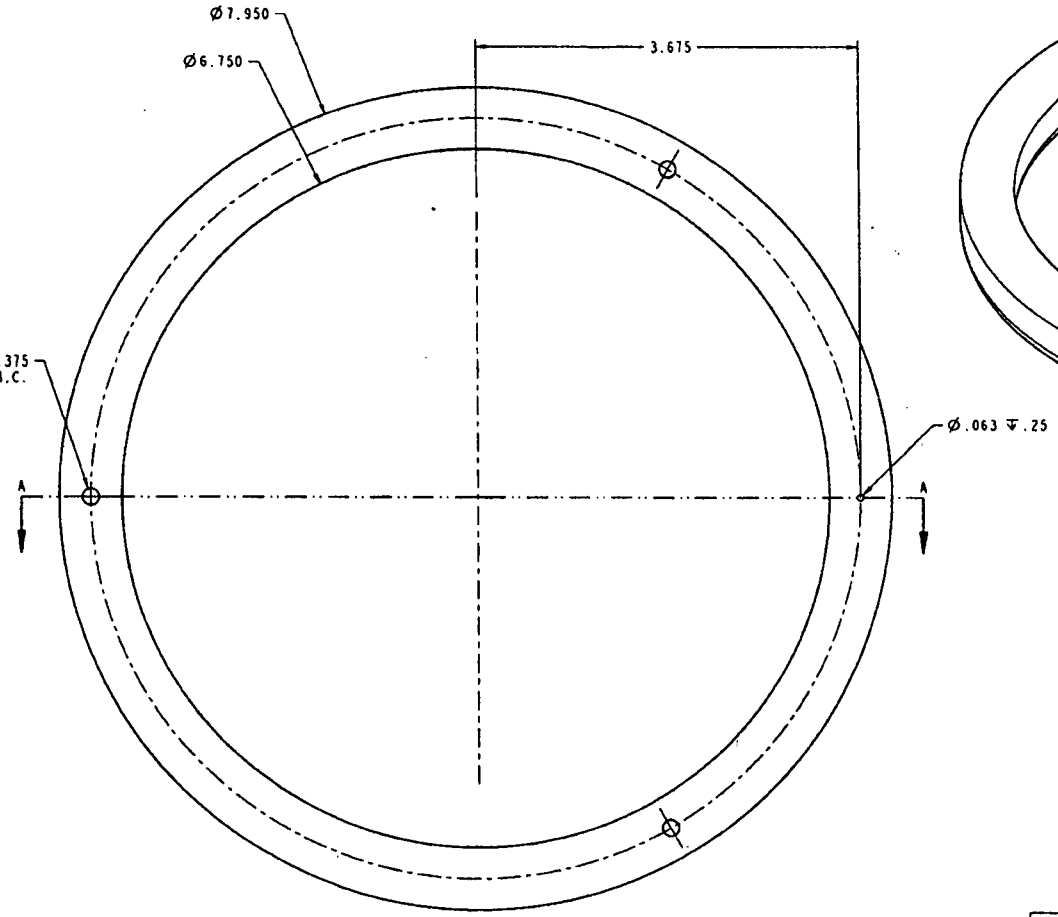


SEMITOOL PROPRIETARY

			JJE		
			DJW		
BASH BOX 31	WHERE USED	DRAW			

TOLERANCES UNLESS NOTED
.XX = ±.020
.XXX = ±.010
ANGULARITY = ±.5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES
UNLESS NOTED

MATERIAL	COPPER 99.9E
FINISH	-
PART NO.	ATG0238

SEMITOOL™ KALISPELL, MT

ANODE, RING, 7.35 DIA.

-

-

SIZE	FSCM NO.	DWG NO	REV
B		ATG0238	
SCALE 0.875		SHEET 1 of 1	

EXHIBIT C

INVENTION DISCLOSURE

D. -0005
B(-00____

SEMITOOL, INC.

Note:
1. Use Ink or Type Only
2. Do not erase errors. Line through any errors, initial and date.
3. Describe invention with drawings, sketches, etc. and a written explanation. Drawings may be below or attached. If attached, the inventor(s) and witnesses must sign and date each sheet.
4. Describe the advantages of this invention compared to the current approach, if any.
5. Inventor(s) and two (2) witnesses must sign and date each sheet.
6. Send original signed documents to the Intellectual Property Department. Retain a personal copy.

Inventor(s) Name

KYLE M. HANSON HENRY . STEVENS
CHRIS K. HAUGAN DANIEL J. WOODRUFF

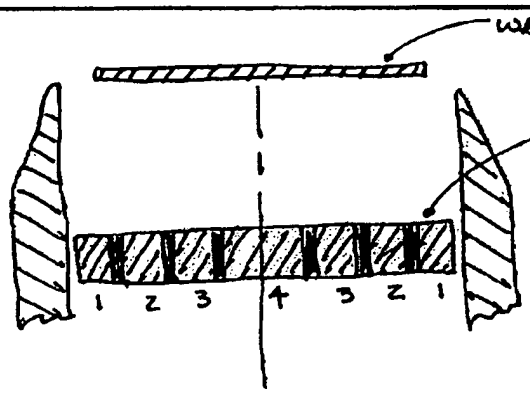
Tool or Process: ELECTRO CHEMICAL DEPOSITION

Title of Invention:

ANODE CONFIGURATION DYNAMIC CONTROL

Invention:

Sketch



(CONCENTRIC RING SEGMENTS SHOWN FOR EXAMPLE)
(OTHER POSSIBILITIES INCLUDE X-Y GRID, CYLINDRICAL COORDINATE ARRY, SPHERICAL COORD. ARRAY ...)

Explanation and Advantages:

Thru the use of a segmented anode structure and independent electrical control on each of these segments (definition of voltage or current flow), the capability to dynamically modify the anode configuration is enabled. This allows for optimization of the anode and therefore reactor current flows in order to compensate for the transient

Signature(s) of Inventor(s):	Date:	Date of Conception:	Date of First Sketch/Drawing:
Chris Haugan Henry Stevens Daniel J. Woodruff			
Witnessed and Understood By:	**Date:**	**Date of Written Description:**	**Working Model Prepared?**
Kyle Hanson M H Tom Lorren			Yes (No) **Date:**

Explanation & Advantages (Con't)

effects from the plated film growth on the wafer. As the film grows on the wafer the current distribution on the wafer will change due to the difference in the film electrical conductivity.

This capability to dynamically alter the anode configuration as the process progresses ~~is~~ becomes more important in the case of high resistance seed layers. In this case, the transient change in the film characteristics is ~~made~~ larger in magnitude as a layer of high electrical conductivity copper, for example, is deposited on a much lower conductivity layer

Th x bles c p. ti'a 5o patter sens-ti' pl x'ng e and ttern sensitive f.l haract ist d othe feature den ty lated electrochem cal ponse for pte local ent density at the fer urface e atched to local f ature density be use the potentia applied to each anode segment n be nd' dually trolled

EXHIBIT D

00474

Work Request

Approved By: DJW

Date:

Circle One:

Jobs #:

Rework

Vendor Rework

Engineering 64736

Return Material

Other:

When Completed Deliver To:

Name: TRACI DELLOW/DAN WOODRUF

Area: ATG

Qty to Job: 1

Qty to Inv: —

☒ Machine Shop

☐ Poly

☐ Weld

Qty Required: 1

Date Needed:

Item/Part #: ATG1724

Description: MOUNT, ANODE/RADIAL ARRAY

Action Required: FAB PER PRINT

Reason:

00475

Work Request

Approved By: DJW

Date:

Circle One:

Jobs #:

Rework

Vendor Rework

Engineering 64736

Return Material

Other:

When Completed Deliver To:

Name: TRACI DELLOW/DAN WOODRU

Area: ATG

Qty to Job: 1

Qty to Inv: —

☑ Machine Shop

☐ Poly

☐ Weld

Qty Required: 1

Date Needed:

Item/Part #: ATG1735

Description: ANODE, RING, 2.12 DIA

Action Required: FAB PER PRINT

Reason:

00476

Work Request

Approved By: DAW

Date: ____

Circle One: | **Jobs #:**

Rework ____

Vendor Rework ____

Engineering 67736

Return Material ____

Other: ____ ____

When Completed Deliver To:

Name: Terri Dezign/Dan Weeks

Area: ATR

Qty to Job: 1

Qty to Inv: —

- [x] Machine Shop
- [ ] Poly
- [ ] Weld

Item/Part #: AT62236

Qty Required: 1

Description: Anvil, Ring, 1.12 DIA

Date Needed: ____

Action Required: Fab Per Print

Reason: ____

00477

Work Request

Approved By: DAW

Date: ____

Circle One: | **Jobs #:**

Rework ____

Vendor Rework ____

Engineering 67736

Return Material ____

Other: ____ ____

When Completed Deliver To:

Name: Terri Dezign/Dan Weeks

Area: ATR

Qty to Job: 1

Qty to Inv: —

- [x] Machine Shop
- [ ] Poly
- [ ] Weld

Item/Part #: AT6237

Qty Required: 1

Description: Anvil, Ring, 5.44 DIA

Date Needed: ____

Action Required: Fab Per Print

Reason: ____

00478

Work Request

Approved By: DAN

Date:

Circle One: | **Jobs #:**

Rework:

Vendor Rework:

Engineering: 69736

Return Material:

Other:

When Completed Deliver To:

Name: Terri Dellow / Dan Woodruff

Area: #727

Qty to Job: 1

Qty to Inv: –

☒ Machine Shop

☐ Poly

☐ Weld

Item/Part #: AP-1220

Description: ANVIL, [illegible] 7.25 DIA

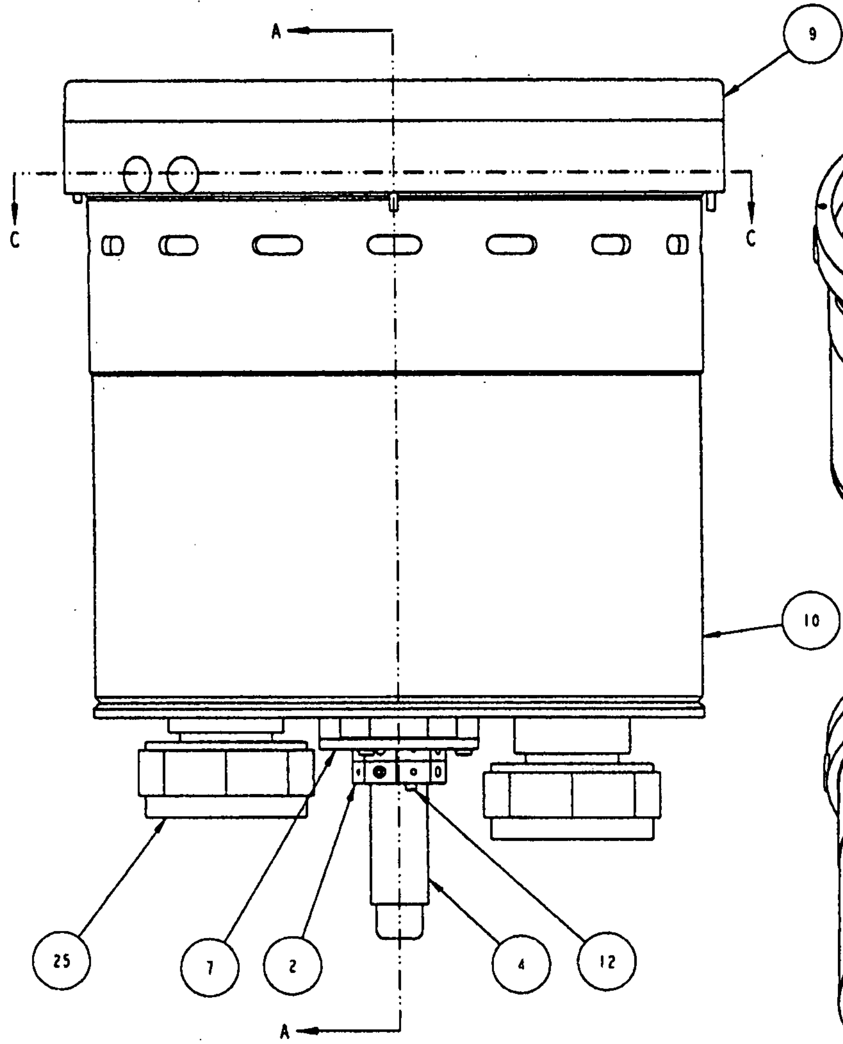
Action Required: [illegible] PRINT

Qty Required: 1

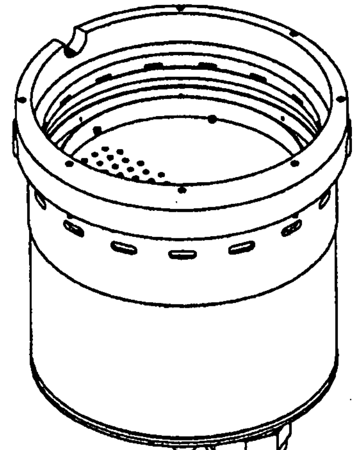
Date Needed:

Reason:

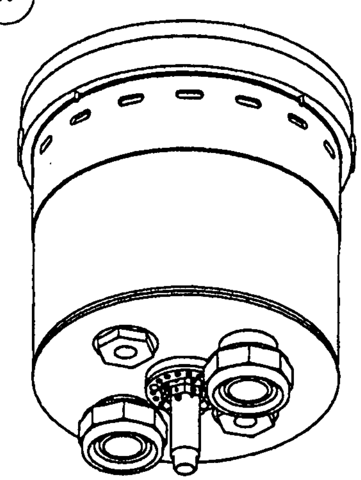
EXHIBIT E



NOTE:
1. DO NOT MOUNT 112T0075-1 UNTIL BOWL IS MOUNTED IN CABINET.



SCALE 0.250



SCALE 0.250

REV	ECN	DESCRIPTION	DISPOSITION	DATE	APPVD

QTY SHOWN	QTY REQD	FIND NO.	PART NUMBER	TYPE	DESCRIPTION
	?		TT0881-14		GASKET, TRUE, 1-1/2
2		28	TW010063201	PART	WASHER FLAT #6 SS
1		27	TO237213	PART	O-RING 2-372 AFLAS TEF-O-SIL
1		26	TO201901	PART	O-RING, 2-019 AFLAS
2		25	TT0881-13	PART	UNION TRUE 1-1/2 SANI-TECH
2		24	TO200701	PART	O-RING, 2-007, AFLAS
2		23	ORNG012001489	PART	O-RING, AFLAS, .070 X 1.489
1		22	ORNG012000989	PART	O-RING, AFLAS, .070 X .989
1		21	LT01776	PART	DIFFUSER, ADJUSTABLE .18 X HEX, 200mm
1		20	LT01412	ASSEMBLY	ANODE ASSY, CONSUM, BACK PROTECT, 200mm
2		19	HSCW10327105	PART	SCREW, PAN HD SLOT, 10-32X5/16, PVDF
3		18	HSCW6327024	PART	SCRW SCKT HD CAP PVDF 6-32 X 1-1/2
3		17	HSCW6327016	PART	SCREW SOCKET HEAD 6-32 X 1 PVDF
5		16	HSCW6321608	PART	SCREW PAN HEAD PHILLIPS 6-32 X 1/2 SS
3		15	HSCW6321234	PART	SCREW, SCKT HD CAP, 6-32 X 2 1/8 SS
1		14	HSCW6321220	PART	SCREW,SKT HD CAP,6-32 X 1-1/4SS
4		13	HSCW6321212	PART	SCRW, SCKT HD CAP, 6-32 X 3/4, SS
2		12	HSCW4401204	PART	SCREW, SCKT HD CAP, 4-40 x 1/4 SS
4		11	12422-505	PART	CAP COUNTERBORE NPP
1		10	112T0076-505	ASSEMBLY	BOWL WELDMENT
1		9	112T0075-1	PART	BOWL, RIM, IMMERSION/PLATING PTFE
1		8	111T0135-03	PART	CUP, UPPER, 200mm, ADJ DIFF, STANDARD HT
1		7	111T0111-1	PART	STOP, ANODE NUT
1		6	111T0100-501	ASSEMBLY	MOUNT, LEVEL SWITCH, PLATING OVR/FULL
1		5	111T0100-1	ASSEMBLY	MOUNT, LEVEL SWITCH, PLATING, BOWL, FULL
1		4	111T0090-1	PART	POST, ANODE
2		3	111T0089-501	PART	PLUG, FEEDTHRU, THIEF USE W/INFLAT. SEAL
2		2	111T0074-1	PART	NUT, ANODE POST
1		1	111T0070-1	PART	CUP LOWER, BOWL, PLATING

100T0041-01

TOLERANCES UNLESS NOTED
.XX = ±.020
.XXX = ±.010
ANGULARITY = ±.5°
BREAK CORNERS - .010 MAX
FILLET RADII - .010 MAX
MACHINED SURFACES
DIMENSIONS ARE IN INCHES
UNLESS NOTED

SEMITOOL™ KALISPELL, MT

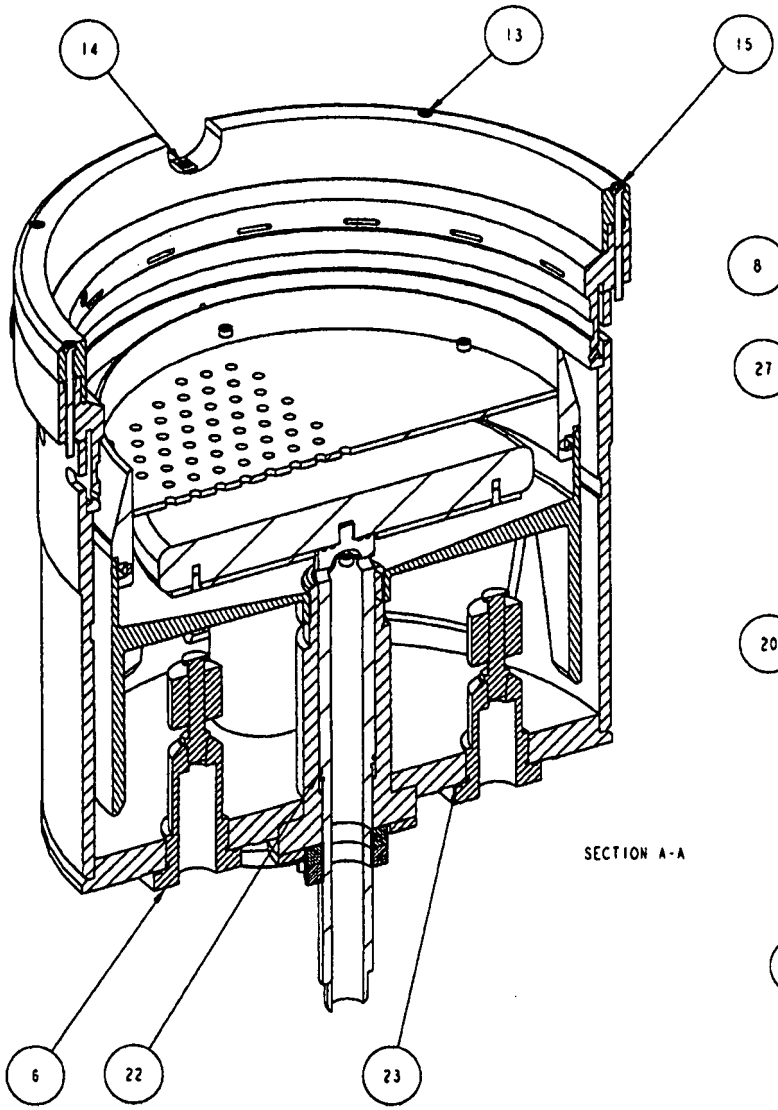
BOWL ASSY, PLATING, CONSUM, FLT LVL, 200mm

BLP
BLP

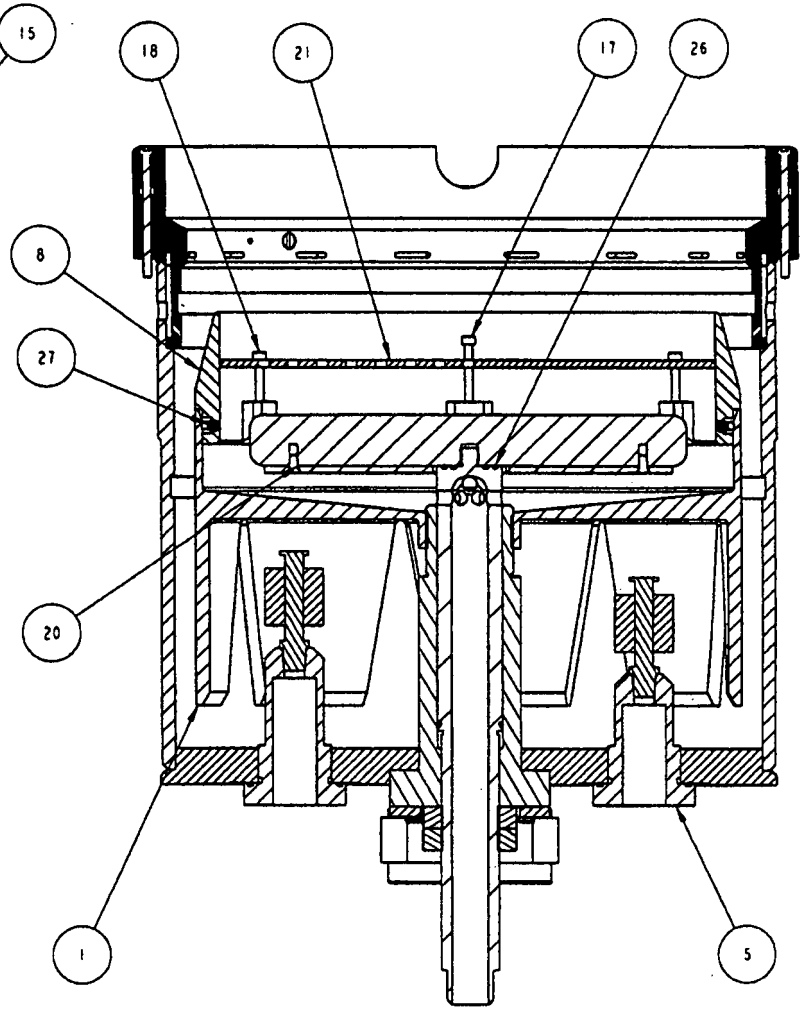
B | 100T0041 | -

SCALE 0.500 | SHEET 1 of 3

SEMITOOL PROPRIETARY

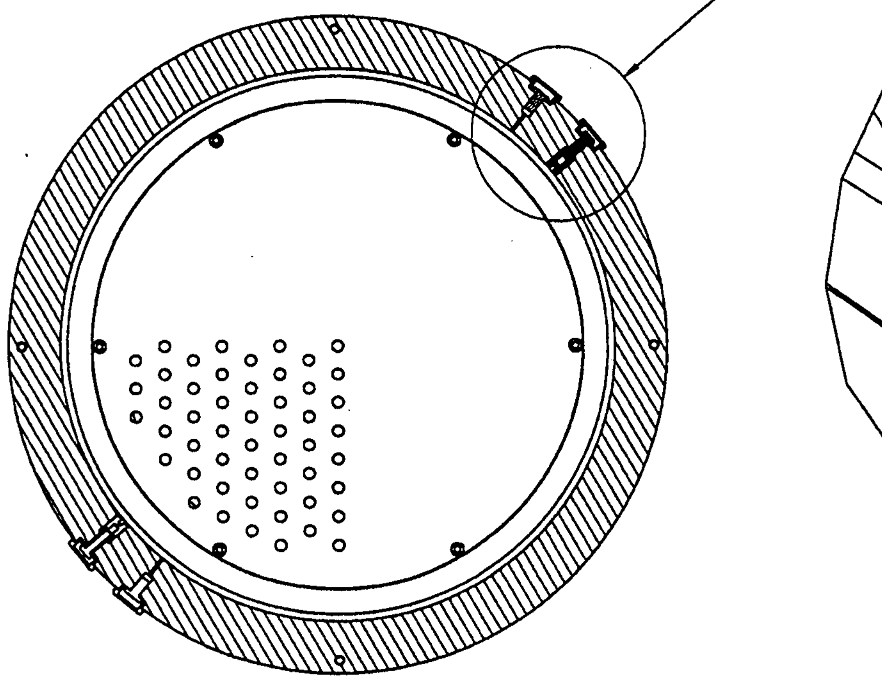


SECTION A-A

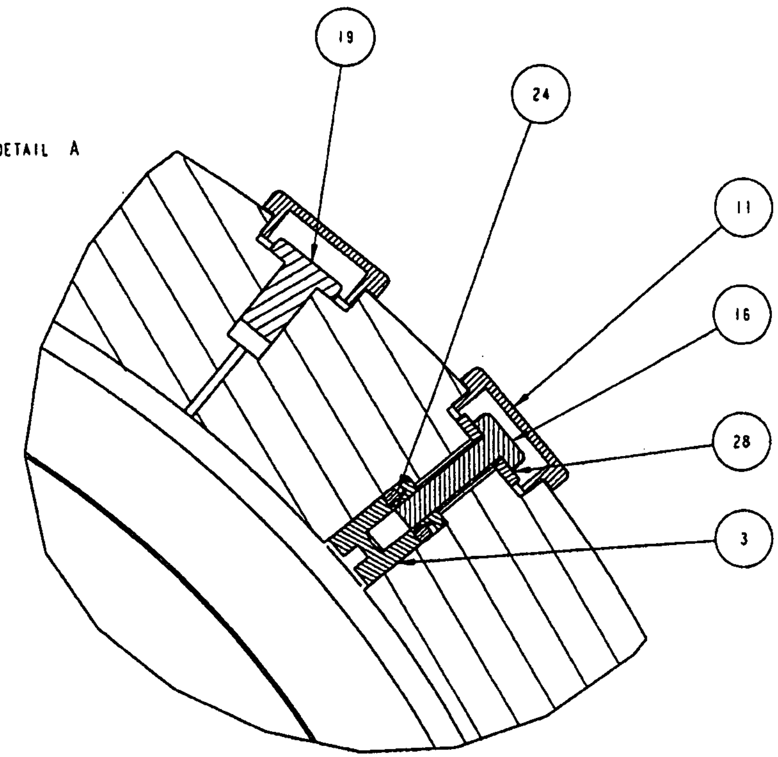


SECTION A-A

DRAWN	BLP	100T0041-01	
CHECKED	BLP	SIZE B	100T0041 REV -
		SCALE 0.500	SHEET 2 of 3



SECTION C-C



DETAIL A
SCALE 2.000

SEMITOOL PROPRIETARY

	100T0041-01		
BLP	B	100T0041	-
BLP	0.500	3 of 3	

EXHIBIT F

THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Daniel J. Woodruff, et al.

Application No.: 10/084,962

Confirmation No.: 2206

Filed: February 27, 2002

Title: ELECTROPLATING APPARATUS WITH SEGMENTED ANODE ARRAY

Art Unit: 742

Examiner: Donald R. Valentine

Docket No.: 114183-7 (P98-0040US2)

DECLARATION UNDER 37 C.F.R. § 1.131
OF DANIEL J. WOODRUFF AND KYLE M. HANSON

We, Daniel J. Woodruff and Kyle M. Hanson, hereby declare and say that:

We are the inventors of the subject matter disclosed and claimed in the above-identified application, having made the invention described therein in the United States. We conceived and reduced to practice the subject matter of the claims in this application prior to April 21, 1998, the earliest filing date claimed by U.S. Patent No. 6,261,433 ("the '433 patent).

2. To demonstrate such prior conception and reduction to practice, we attach hereto as Exhibit A our Invention Disclosure for the concentric anode array reactor and, as Exhibit B our Invention Record describing the anode

configuration, both forming the basis for the drawings contained in the above-identified application. Exhibit A, naming ourselves as inventors thereof, was prepared and signed by us well prior to April 21, 1998 and lists dates of conception and written description also prior to April 21, 1998. In addition, Exhibit A was witnessed and understood by two colleagues at Semitool, Inc., also prior to April 21, 1998.

3. Exhibit B which we both signed was also prepared prior to April 21, 1998 and witnessed before that same date. Together, Exhibits A and B were used in the preparation of the drawings contained in the present application, thus establishing conception of the method and apparatus disclosed in the above-identified application prior to April 21, 1998.

4. The segmented anode described in the present application is shown in Semitool engineering drawings, Exhibits C, D. E, F, G, H and I, just as described in the present application. The drawings of Exhibits C-I were each made prior to April 21, 1998 and were used to construct the segmented anode at the facility of Semitool, Inc. in Kalispell, Montana. That segmented anode was built, installed in a plating reactor as described in the present application and shown in Exhibits A and B, and that apparatus was successfully tested prior to April 21, 1998.

5. The dates contained on each of the exhibits have been removed, but all are prior to April 21, 1998, and thus corroborate conception and reduction to practice of the subject matter disclosed and claimed in the present application.

6. hereby declare under the penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge and belief.

7. Further declarants sayeth not.

Executed this 23rd day of March, 2005 in Kalispell, Montana.

Daniel J. Woodruff

Kyle M. Hanson

INVENTION DISCLOSURE

SEMITOOL, INC. D 0006

Note: 1. Use Ink or Type Only
2. Do not erase errors. Line through any errors, initial and date.
3. Describe invention with drawings, sketches, etc. and a written explanation. Drawings may be below or attached. If attached, the inventor(s) and witnesses must sign and date each sheet.
4. Describe the advantages of this invention compared to the current approach, if any.
5. Inventor(s) and two (2) witnesses must sign and date each sheet.
6. Send original signed documents to the Intellectual Property Department. Retain a personal copy.

Inventor(s) Name and Social Security Number

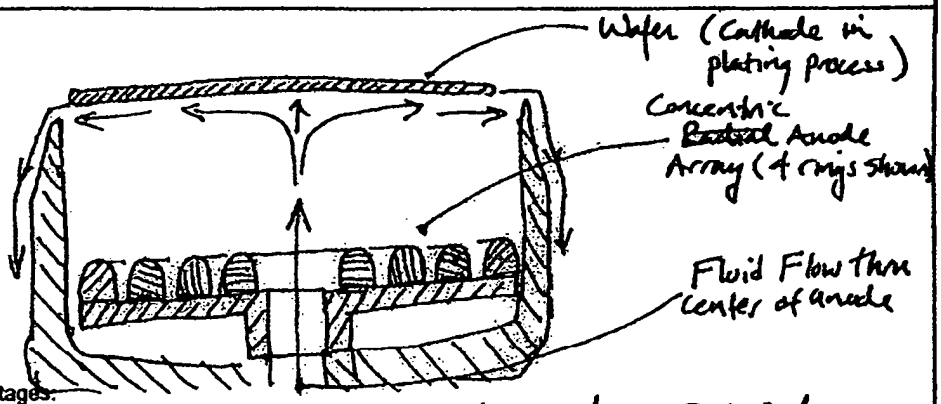
Daniel J. Woodruff
Kyle M. Hanson

Title of Invention: TOOL: Plating

Concentric Anode Array with Centered Fluid Flow

Invention:

Sketch



Explanation and Advantages:

Plating fluid is pumped through the center of the anode array and impinges on the wafer surface. The plating rate on the wafer surface will vary radially ~~across the~~ due to the effect of the impinging fluid on the hydrodynamic boundary layer. This radial effect can be compensated for ~~in the~~ by operating the anode rings at different electrical potentials.

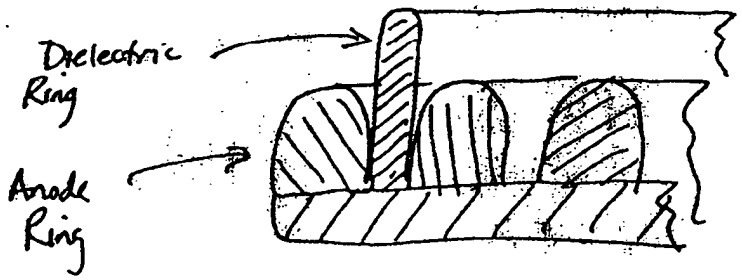
(continued on attached sheet)

Signature(s) of Inventor(s):	Date:	Date of Conception:	Date of First Sketch/Drawing:
Daniel J. Woodruff Kyle M. Hanson			
Witnessed and Understood By:	**Date:**	**Date of Written Description:**	**Working Model Prepared?**
Thomas L. Ritzdorf R. W. Cox			Yes/No Date:

[redacted]

Explanation and Advantages (Cont.)

In addition to affecting plating uniformity by using different anode potentials it would also be possible to affect uniformity with dielectric (insulating) material placed between the anode ring (see sketch



The geometry of the dielectric material could be modified to provide the desired effect on plating. Tall geometries would tend to limit interaction of adjacent anodes (and perhaps ultimate current flow to the wafer) while shorter or perforated geometries would tend to increase anode interaction. Similar effects may also be possible by positioning the anode rings at varying distances from the wafer surface.

The advantages to this design are:

1) No diffuser is required between the anode and wafer. Fluid flow rate and current distribution can be controlled independent of one another in the proposed design, but can't in the existing system which uses a diffuser constructed of dielectric material. Having these variable independently controllable makes it easier to optimize the plating process.
2) Air bubbles introduced into the plating chamber by the incoming fluid flow are simply flushed passed the wafer surface and won't interfere with the plating process. With the existing system utilizing a diffuser these bubbles can attach to the diffuser surface and adversely impact diffuser performance
3) Fluid flow through the center of the anode ensures the wafer surface will be wetted from the center out. This will prevent air being trapped at the center of the wafer when it first contacts the fluid surface

David G. Wadsuff
Kurt Hess

INVENTION DISCLOSURE

ID. -0005
ID -00____

SEMITOOL, INC.

Note:
1. Use Ink or Type Only
2. Do not erase errors. Line through any errors, initial and date.
3. Describe invention with drawings, sketches, etc. and a written explanation. Drawings may be below or attached. If attached, the inventor(s) and witnesses must sign and date each sheet.
4. Describe the advantages of this invention compared to the current approach, if any.
5. Inventor(s) and two (2) witnesses must sign and date each sheet.
6. Send original signed documents to the Intellectual Property Department. Retain a personal copy.

Inventor(s) Name

KYLE M. HANSON — HENRY . STEVENS
CHRIS K. HAUGAN — DANIEL J. WOODRUFF

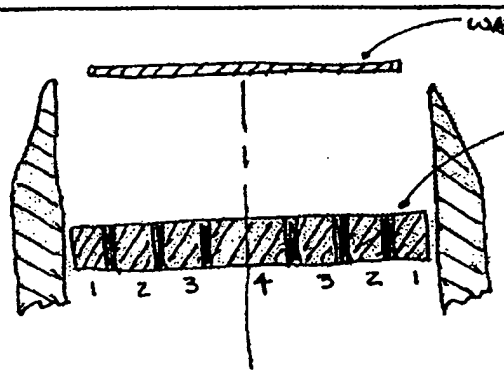
Tool or Process: ELECTRO CHEMICAL DEPOSITION

Title of Invention:

ANODE CONFIGURATION DYNAMIC CONTROL

Invention:

Sketch



(CONCENTRIC RING SEGMENTS SHOWN FOR EXAMPLE)
(OTHER POSSIBILITIES INCLUDE X-Y GRID, CYLINDRICAL COORDINATE ARRY, SPHERICAL COORD. ARRAY ...)

Explanation and Advantages:

Then the use of a segmented anode structure and independent electrical control on each of these segments (definition of voltage or current flow), the capability to dynamically modify the anode configuration is enabled. This allows for optimization of the anode and therefore reactor current flow in order to compensate for the transient

Signature(s) of Inventor(s):	Date:	Date of Conception:	Date of First Sketch/Drawing:
Chris Haugan Henry Stevens Daniel J. Woodruff			
Witnessed and Understood By:	**Date:**	**Date of Written Description:**	**Working Model Prepared?**
Kyle Hanson [illegible]			Yes (No)
[illegible]			**Date:**

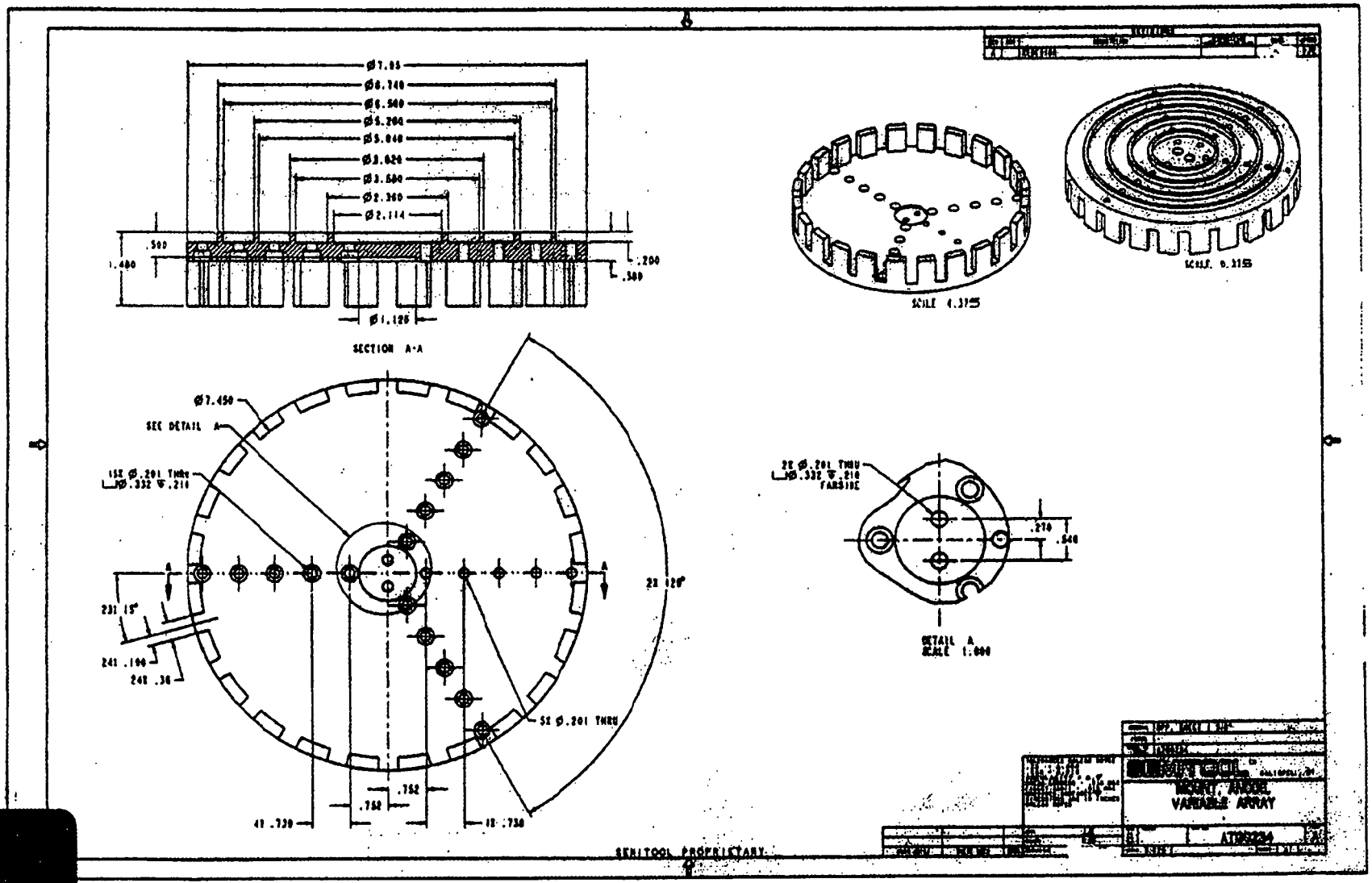
[redacted]

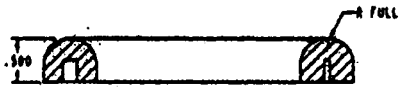
Explanation & Other Pages (Con't)

effects from the plated film growth on the wafer. As the film grows on the wafer the current distribution on the wafer will change due to the difference in the films electrical conductivity.

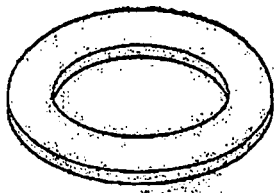
This capability to dynamically alter the anode configuration as the process progresses is becomes more important in the case of high resistance seed layers. In this case, the transient change in the film characteristics is ~~made~~ larger in magnitude as a layer of high electrical conductivity copper, for example, is deposited on a much lower conductivity layer

Th x bles c p. ti'a 5o
patter sens'ti' pl t'ing e ~~and~~ then sensitive
f.l haract ist d other feature den ty lated
electrochem cal ponse for ple local nt density
at the fer urface e atched to local f ature
density, be use the potentia applied to each anode
segment n be nd' dually trolled


SECTION A-A
DETAIL A
SCALE 1:000
SCALE 0.315
SCALE 0.315
SEE DETAIL A
SERITOOL PROPRIETARY
VARIABLE ARRAY



SECTION A-A



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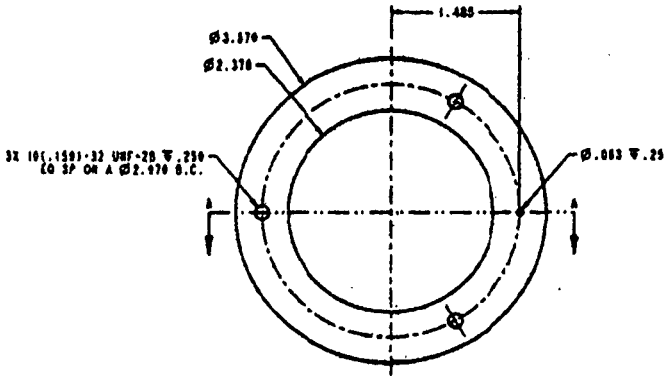


NOTES:

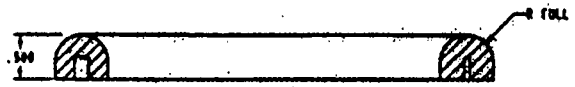
1. CHEMICAL COMPOSITION

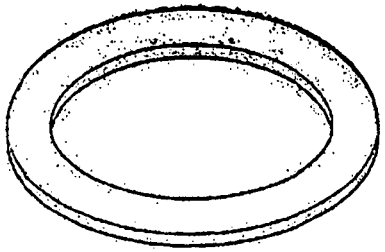
	PERCENT %
*COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.003 MAX.
SULFUR	0.003 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAX.

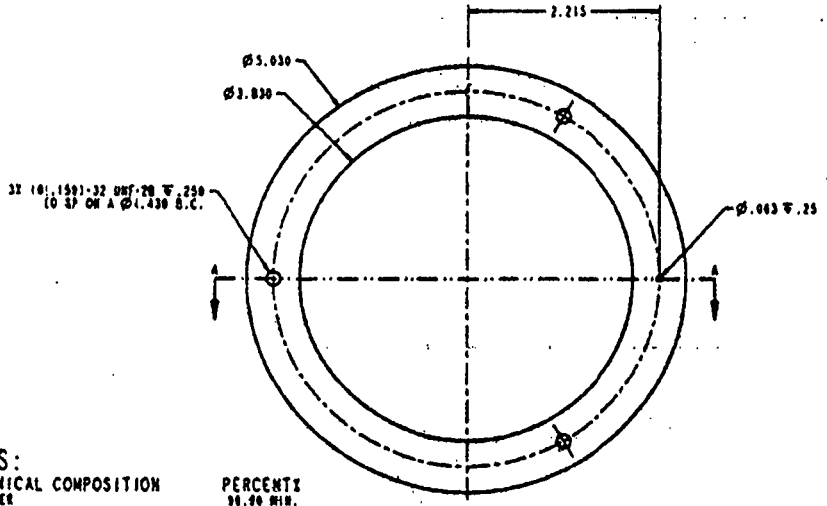
*SILVER COUNTED AS COPPER

2. MATERIAL CERTIFICATION TO BE PROVIDED WITH RAW MATERIAL.

ANODE, RND. 2.87 DIA.







NOTES:

1. CHEMICAL COMPOSITION

	PERCENT‡
*COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.003 MAX.
SULFER	0.003 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAS.

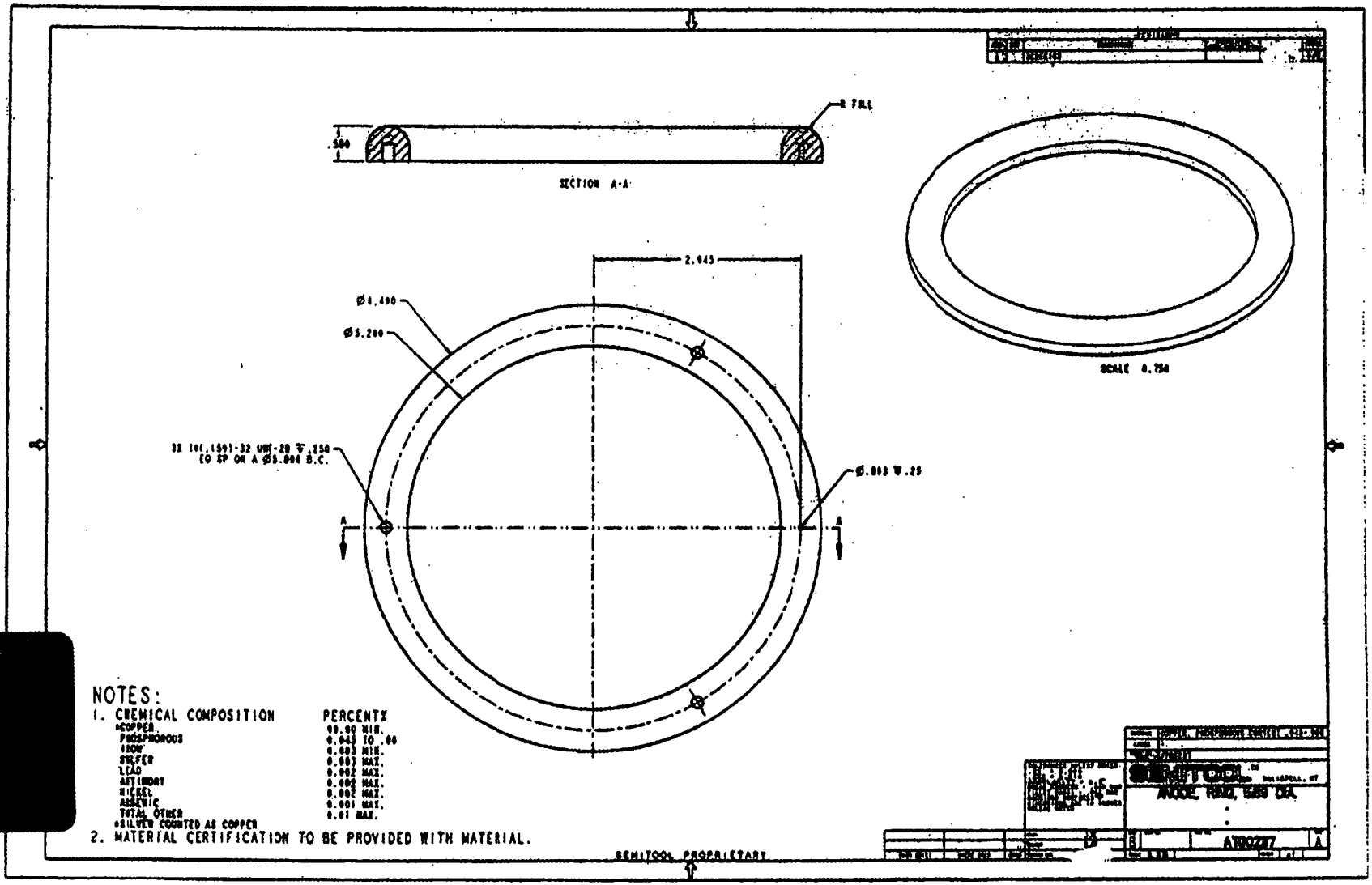
*SILVER COUNTED AS COPPER

2. MATERIAL CERTIFICATION TO BE PROVIDED WITH RAW MATERIAL.

ANODE, RING, 4.43 DIA.

A100228 A

SEMITOOL PROPRIETARY



NOTES:

1. CHEMICAL COMPOSITION

	PERCENT%
*COPPER	99.90 MIN.
PHOSPHOROUS	0.045 TO .06
IRON	0.005 MIN.
SILVER	0.005 MAX.
LEAD	0.002 MAX.
ANTIMONY	0.002 MAX.
NICKEL	0.002 MAX.
ARSENIC	0.001 MAX.
TOTAL OTHER	0.01 MAX.

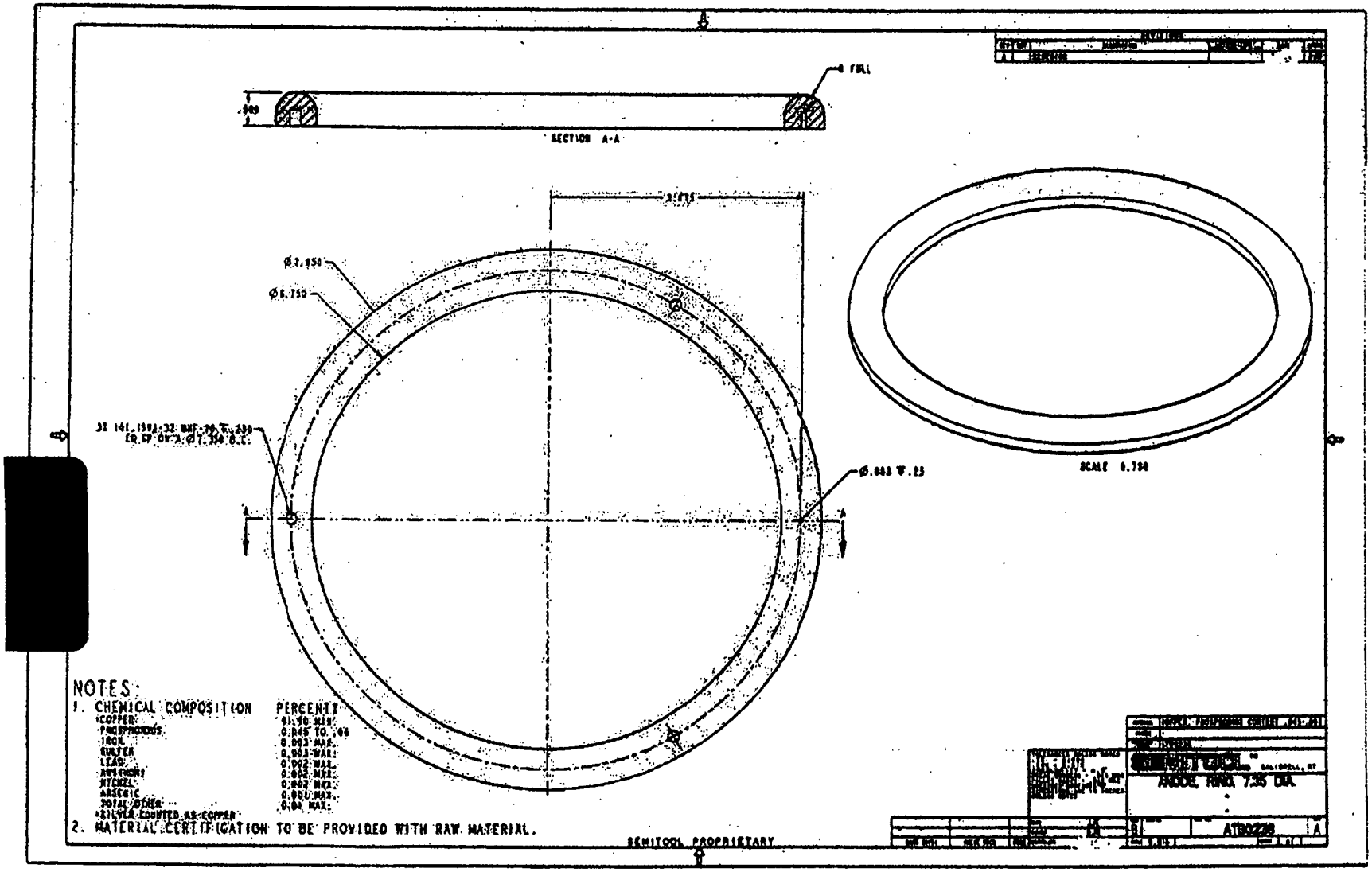
*SILVER COUNTED AS COPPER

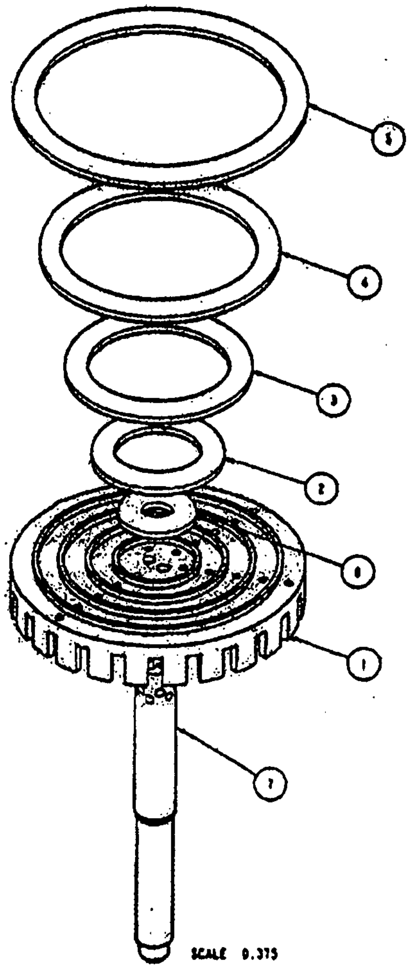
2. MATERIAL CERTIFICATION TO BE PROVIDED WITH MATERIAL.

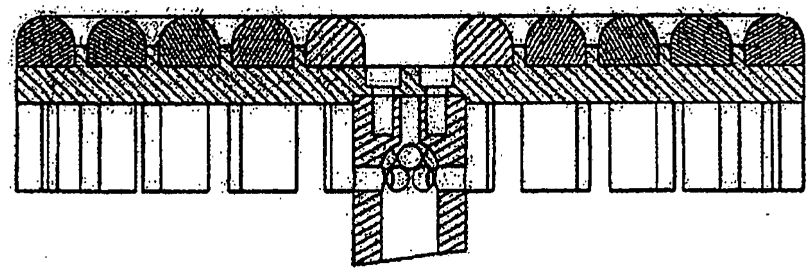
SEMITOOL

ANODE, RING, 5.89 DIA.

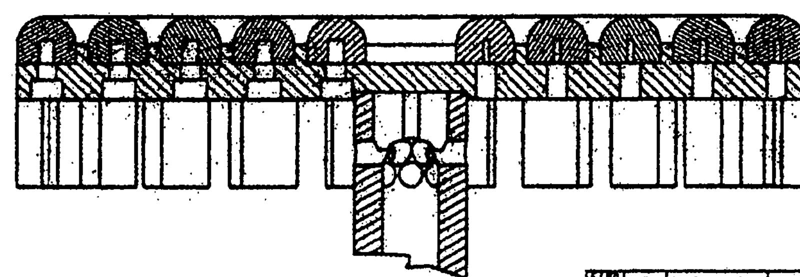
A700287


SECTION A-A
Ø7.850
Ø6.750
SCALE 0.750
NOTES:
1. CHEMICAL COMPOSITION PERCENT
2. MATERIAL CERTIFICATION TO BE PROVIDED WITH RAW MATERIAL.
SEMITOOL PROPRIETARY
ANODE, RING, 7.35 DIA.
A1B0239
A





SECTION D-D

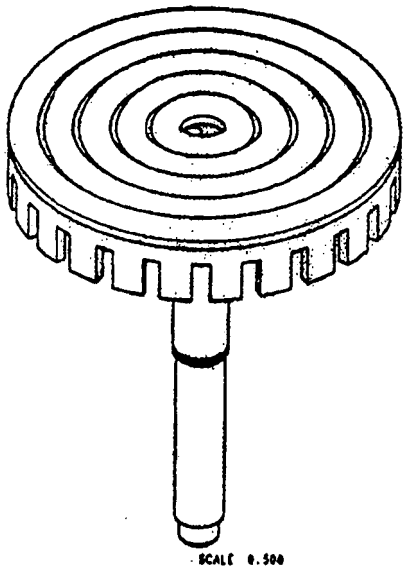


SECTION C-C

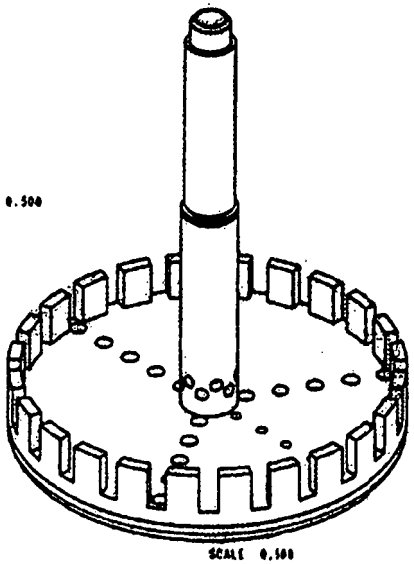
FIND No.	QTY	PART NUMBER	DESCRIPTION
1	1	AT000234	MOUNT, ANODE, RADIAL ARRAY
2	1	AT000235	ANODE, RING, 2.87 DIA.
3	1	AT000236	ANODE, RING, 4.43 DIA.
4	1	AT000237	ANODE, RING, 5.98 DIA.
5	1	[illegible]	ANODE, RING, 7.38 DIA.
6	1	[illegible]	ANODE, RING, 2.87 DIA.
7	1	[illegible]	POST, ANODE, CONSUMABLE NOT PLATED

SEMITOOL
ANODE ASSEMBLY, VARIABLE ARRAY
AT000233

SEMITOOL PROPRIETARY



SCALE 0.500



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